COUNTY WASTE MANAGEMENT CENTRE MARIŠĆINA

ENVIRONMENTAL IMPACT ASSESSMENT
-EXECUTIVE SUMMARY-

December 2009
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## CONTENT

1. INTRODUCTION .............................................................................................................................. 3  
2. PROJECT DESCRIPTION ............................................................................................................... 3  
3. ANALYSIS OF ALTERNATIVES......................................................................................................... 19  
4. ENVIRONMENTAL IMPACT ASSESSMENT APPROVAL PROCESS ........................................ 30  
5. DESCRIPTION OF EXISTING ENVIRONMENT ........................................................................ 32  
6. DESCRIPTION OF ENVIRONMENT LIKELY AFFECTED BY PROJECT ..................................... 34  
7. MITIGATING MEASURES ........................................................................................................... 37  
8. REQUIRED MONITORING PROGRAM ........................................................................................ 41
1 INTRODUCTION

This report is an executive summary of the completed Environmental Impact Assessment (EIA) for County Waste Management Centre (CWMC) Marišćina, Primorsko Goranska County (PGC), as well as an overview of the Project, proscribed mitigation measures and required monitoring program.

<table>
<thead>
<tr>
<th>Project Name</th>
<th>County Waste Management Centre Marišćina</th>
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</thead>
<tbody>
<tr>
<td>Sector</td>
<td>Waste management sector</td>
</tr>
<tr>
<td>Area Impacted by the Project</td>
<td>Country: Republic of Croatia</td>
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<tr>
<td></td>
<td>County: Primorsko Goranska County</td>
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<td></td>
<td>Population: 305,505 (2001)</td>
</tr>
</tbody>
</table>

2 PROJECT DESCRIPTION

Municipal waste management in Croatia is undergoing a radical transformation from decentralised disposal of non-treated waste on numerous local sub-standard landfills within counties to centralized waste management at Waste Management Centres (WMC) serving needs of one county, or, in some cases, of several counties. The WMC concept has been adopted by the Croatian Government in its National Waste Management Plan.

At the moment in PGC municipal waste collection and disposal activities are performed by 9 municipal companies on 10 official landfills.

Under such circumstances PGC has also defined strategy for establishing of integrated waste system (Figure 3) and establishment of the CWMC Marišćina is main objective of the strategy.

PGC selected the location “Marišćina” in the Municipality of Viškovo (Figure 1 and 2) as the most appropriate site for the future CWMC. The Final Environmental Impact Assessment Study was conducted in 2001. Based on the EIA, Marišćina, as the best location for the future CWMC was adopted in County Physical Plan and County Waste Management Plan. Public Utility Company Ekoplus Ltd has been established in year 2001 by the County for waste management at the County level. From that time numerous of technical documentation has been prepared (Please see Chapter 2.1) and land acquisition at the site Marišćina is performed by Ekoplus Ltd.
Figure 1. Position of the CWMC Marišćina within the Primorsko-goranska County
CWMC Marišćina will accept municipal waste, non-hazardous industrial waste and recyclable waste material. Special regulations for specific waste categories (packaging waste, waste tyres, electrical and electronic waste, etc.) have been in force and a part of municipal waste will be collected through a separate collection system and may be conveyed directly or over a recycling yards at transfer stations (TS) or at CWMC to material or energy recovery. The remainder of the mixed municipal waste will be collected in an organized way by companies licensed for municipal waste collection (current waste collection companies) that will transport collected waste to TS or directly to the CWMC. Non-hazardous industrial waste after the treatment (if needed) will be collected separately from municipal waste by an organized system of licensed collectors and transported separately to the CWMC. Separately collected delivered recyclable waste material will be received at the recycling yard in the CWMC.
New county waste management system is designed as follows:

**Figure 3.** Block diagram of municipal and non-hazardous industrial waste management system in PGC

(Source: NWMP)

Municipal waste will be treated in the mechanical-biological treatment plant (MBT) before disposal. Outputs of the MBT Plant will be: reusable waste fraction – metals; solid recovered fuel (SRF) and biodegradable fraction of municipal waste. SRF will be shipped for further treatment. Biodegradable fraction of waste will be disposed on the appropriate landfill cell, “controlled bio-reactive landfill” cell (CBL), where the biogas production will take place under controlled conditions with the aim of electricity production. Non-hazardous industrial waste will be disposed on the appropriate landfill cell. Recyclable waste materials will be shipped for treatment outside the centre.
2.1 Technical description of CWMC Marišćina

The CWMC Marišćina consists of several technical-technological units and facilities, but can generally be divided into the entrance area, disposal area and working area. It covers total area of 42,5 ha of which 5,5 ha is the working area, 21 ha the disposal area, 1,5 ha the protection green area, 2,4 ha internal and external roads and about 2,1 ha the fire protection area. The total capacity of the landfill area satisfies the needs of the PGC for waste landfilling up to year 2040.

Figure 4. Overview of the CWMC Marišćina

CWMC Marišćina will accept pre-treated nonhazardous industrial waste and accept and treat municipal waste. Accordingly to that waste flows (Figure 5) CWMC has been designed.
2.1.1 Municipal waste flow

After the acceptance, inspection, weighting and registration delivered municipal waste will be transported to the Mechanical Biological Treatment Plant. Where will be treated in the following stages:

- **Receiving of incoming Municipal Waste**
  
  The incoming municipal waste will be unloaded, through the rapid opening doors, opened only for the unloading, into an underground pit inside the building. All waste handling will be operated by programmable bridge cranes, completely automated, and checked from the control room.

- **Mechanical pre-treatment - waste screening and bag splitting**

  From the incoming pit the bridge crane will automatically feed the wastes into the drum screener, where waste bags are opened with special blades and then waste will be screened to the two size fraction. Then both fractions will be transported to the appropriate acceptance pits, for the further treatment.

- **Bio-drying of waste**

  After mechanical pretreatment of municipal waste, smaller fraction will be transported to the area for bio-drying. The waste will be piled in this area for high 5 to 6m, depending on waste composition. The organic fraction of the municipal waste, for the presence of water, carbon and nitrogen, is instable,
able to ferment both aerobically and anaerobically. In the process, all the fermentable organic part (putrescible fraction) undergoes aerobic fermentation while releasing heat. This heat will be used both in order to additionally dry the dry fraction and to thermally hygienise the recovered parts, while guaranteeing a higher health and safety level during the treatment itself and in subsequent handling. The system developed does not aim only at managing the aerobic process in order to obtain humidified organic substance, but also to best exploit the exothermy of the process to dry the totality of the waste in the least time possible. Due to the high temperatures reached in the mass (50-60°C), this aerobic process is a valid system for stabilizing, deodorizing and hygienising the material. This is a 12 - 15 days static process.

The perforated floor and ductwork system allows process air to be drawn through the waste and transferred to the bio-filters mounted behind MBT Plant building. At the end of the process, starting with material with a water content around 30-40% (typical water content of un-segregated municipal waste or residue from waste sorting), the material obtained contains less than 20% of water. During the process total waste weigh decrees for 25 to 30%. The sucked air from area of bio-drying is treated in the bio-filter. After treatment air is clean, without bad odour, so it is save to release that air in the atmosphere. Once the bio-drying is completed waste is automatically loaded by the bridge crane to the drumscreen for additional mechanical treatment.

- Mechanical Refining (SRF production)

The mechanical treatment line is consisted from conveyers, screens and separators, with main task – producing of solid recovered fuel (SRF) with appropriate composition for industrial furnace (Cement Plants).

Mechanical refining line is consisted from:

Drumscreen - (here material fraction <20mm (mostly biological and inert fraction) is separated like methanogenic waste fraction and is transferred to the bio-reactive landfill cell)

Air-separator – the purpose of air separator is separation of material with low api gravity, mostly plastics, paper, cardboard and similar (as that material has high-calorific value it can be used as solid recovery fuel (SRF), from inert "heavy" fraction – methanogenic fraction (mostly biological and inert fraction with bigger dimension)
Shredder – SRF fraction is shredded here to the final fraction dimensions from 20 to the 100 mm, depending of usage

Magnetic separator allows the separations of all ferrous materials that can be sent to recovery; further Eddy-current separator enables the separation of aluminum, cooper and non-ferrous metals

– Solid recovery fuel (SRF)

SRF given by this process has guaranteed minimal calorific value around 16 – 18 MJ/kg. It will be transported outside the CWMC for the further treatment.

– Bio-reactive landfill cell – disposal and further treatment of methanogenic fraction.

The bioreactive landfill technology is based on the acceleration of the anaerobic degradation of the methanogenic (biodegradable) fraction of the waste leading to its mineralisation. This technology is developed due to specific characteristic of metanogenic fraction of municipal waste – it has high potential for methane production but only with addition of certain amount of water. This fraction does not contain easily degradable fraction of waste (due to process of bio-drying) and it is dry and partly stabilized, which means that during the process of disposing landfill gasses and lechate production are minimal, bad smells and animals on landfill are eliminated. After the cell will be closed process of biodegradation and methane production will be started with controlled liquid addition in closed landfill body by the system of horizontal pipes build in waste body during the disposal. Liquid which is foreseen to be added is purified lechate at the WWTP. Whole process of methane production and collection will be controlled and monitored. As this technology ensures high rate of methane production as well uniform rate of production trough the time, production of electrical energy from landfill gasses is foreseen at the CWMC.

Bio-reactive landfill will be divided in landfill cell with each capacity for 5 years of disposal.

Bottom sealing landfill cell layer is consisted from following layers:

- Leveling layer 50 cm
- Geosynthetic clay liner
- HDPE geomembrane 2,5 mm
- Protective geotextile 1.200 g/cm2
- Drainage layer 50 cm
- Geogrid
Leachate collection in each landfill cell is made utilizing perforated polyethylene pipes that are laid within the drainage layer. Transfer of the leachate from the landfill cells to the buffer pond is done by polyethylene pipes. Leachate from the buffer pond is pumped to the Waste Water Treatment Plant for processing.

Each landfill cell will be covered with top sealing layer designed as follows:
- Leveling gas drainage layer (30 cm)
- Geosynthetic clay liner
- Geodrain
- Top soil cover (100 cm)
- Grass

### 2.1.2 Non-hazardous industrial waste flow

After the acceptance, inspection, weighting and registration delivered non-hazardous industrial waste will be transported to the landfill cell for non-hazardous industrial waste. There will be no additional treatment of that type of waste at the CWMC due to the fact that only pre-treated nonhazardous industrial waste is acceptable at the CWMC (it has to fulfil criteria for acceptance of waste at landfills for non-hazardous waste given by Ordinance on the methods and conditions for the landfill of waste, categories and operational requirements for waste landfills (OG 117/07).

This landfill cell will have same bottom sealing layer, lechate collection system and top sealing layer as bio-reactive landfill cell (described in Chapter 2.1.2).

### 2.1.3 Common infrastructure of the CWMC

For normal function of CWMC it will include following as well:

- **Gas Collection Systems**

  Two types of degassing are foreseen for the CWMC Marišćina: gas collection system for the bio-reactive landfill cell – active degassing and gas collection system for the non-hazardous landfill cell – passive degassing

  Gas extraction shafts are built into the new dumping area so that each shaft is capable of extracting gas from an area of about 50 m in diameter.

  Gas which will be extracted from the open bio-reactive cell will be burned off at gas flare (active degassing). After full closure of the bio-reactive cells gas will be utilized for the production of the electrical energy.

  Passive degassing it is foreseen for the non-hazardous waste.
- **Waste water treatment plant (WWTP)**

Waste water treatment plant will treat following waste waters: landfill leachate, landfill gas condensate, waste water from washing of working areas, waste water from the bio-filter, waste water from washing internal and roofed areas, sanitary waste water, wheel- and truck-washing waste water, waste water from MBT plant and waste water from the transport centre. The WWTP will produce an effluent that will be discharged to the natural recipient thru infiltration wells. Boundary values and permitted concentrations of hazardous and other substances in effluent to be discharged into the natural recipient are specified in Ordinance on Boundary Values of Dangerous and Other Substances in Waste Waters (OG 94/08).

- **Other CWMC structures**

For normal operating of CWMC following structures are foreseen to be constructed: perimeter fence, internal CWMC roads and parking, guarding hose at the entrance of CWMC, weighbridge, facility for wheel wash, administrative building, maintenance building and recycling yard etc.

- **Monitoring**

Construction of the inspection wells around the landfill is necessary for monitoring of the ground water. Other monitoring requirements are prescribed in Environmental Impact Assessment: Decision of the Ministry of the Environmental Protection and Physical Planning, class: UP/I-351-02/00-06/31, reg. number: 531-05/03 of March 31, 2003.

### 2.2 Transfer stations

Transfer stations are also one of the essential parts of the system that has to be established. For the PGC is foreseen construction of 5 TSs (Delnice, Novi Vinodolski, Krk, Cres and Rab). The purpose of TSs is to receive waste from the surrounding settlements; the waste will be transloaded into the vehicles for long distance transport. Trucks with full semi-trailers will be forwarded to the CWMC.
2.3 The Project background documents

The preparation of the project CWMC Marišćina had started in 1995 and from that period of time a large number of studies and projects documentation on the subject of waste management and CWMC Marišćina were prepared. Meanwhile, the waste management technology has been improved and because of the harmonisation of environmental legislation of the Republic of Croatia with the EU legislation, new legislation has been put into force.
One of the first comprehensive documents expounding the principles of waste management in the Primorsko – Goranska and Istarska Counties is the study “System of Waste Management in the Kvarner and Istria Region” (Ramboll, Hannemann & Hojlund A/S, 1996) which was completed within the METAP Programme of the European Investment Bank from Luxembourg. This study in a comprehensive way elaborated the need to establish an integral system of waste management for both counties, foreseeing two sanitary landfills, but favouring a thermal treatment of waste (incinerator), a proposal which was later rejected. In spite of that, the study provides a basis for the development of a new approach to the management of municipal and non-hazardous industrial waste in the Primorsko – Goranska County.

In 1995, IGH – Zagreb completed its “Report on the Results of Exploration of a New Location for the Disposal of Municipal Waste – Phase I” which focuses on the locations Rojno, Draga, Dolčina and Laze as potential solutions to the problem of waste disposal.

In 1997, IGH – Zagreb completed the “Concept Solution for Municipal Landfills Dolčina and Nova” which presupposes the construction of sanitary landfills without any other infrastructural buildings related to integral waste management. In 1998, IGH – Zagreb conducted an exploration of the localities of Rojno, Dolčina, Nova and Marišćina. The locations Dolčina and Laze were dropped due to findings of additional hydro-geological studies.

In 1999 the "Preliminary Study of Environmental Effects of a Facility for Storage, Treatment, and Disposal of Municipal and Non-Hazardous Industrial Waste from PGC area" was completed. (Ekonerg Holding d.o.o., Zagreb, June 1999).

In 2001 the “Final Study on Environmental Impact of the Building for Storage, Treatment and Disposal of Municipal and Non-hazardous Technological Waste from the Primorsko – Goranska County” was completed (Ekonerg Holding d.o.o., Zagreb, March 2001). This document supported the decision to choose Marišćina as a location of the future Regional Centre for Waste Management.

Then came the “Basic Design of the Central Zone for Waste Management Marišćina” (ECOINA d.o.o., Company for Environmental Protection, Zagreb, May 2003). This study was done in response to the need to integrate the data and elaboration of the basic premises of the “Final Study...” with the elements of the concept design and the technological project of the location. It elaborates the specific features of the location in a functional sense, dealing with spatial, technical, technological, traffic and other factors.

Expert Opinion for the Issuing of the Location Permit for the Central Zone for Waste Management Marišćina” (ECOINA d.o.o., Company for Environmental Protection, Zagreb) was completed in July 2003. It represents the basis for the issuing of the location permit and contains all the basic elements prescribed by Croatian
legislation, in view of the fact that the permit has been issued in accordance with the regulations of the Physical Plan of the Primorsko – Goranska County.

The study “Determination of Morphological and other Physical and Chemical Structures of Municipal Waste of the Primorsko-Goranska County” (ECOINA d.o.o. Company for Environmental Protection, Zagreb) was completed in October 2003. Four measurement cycles and analyses in year 2002 and 2003 were carried out on fresh and untreated waste, whereby the necessary parameters for designing the capacities and structure of the CWMC “Marišćina” were obtained.

“Conceptual Design for the Issuing of the Preliminary Permit for the CWMC „Marišćina”” (ECOINA d.o.o., Company for Environmental Protection, Zagreb) was completed in May 2004. The conceptual project is based on previous documentation and served as a basis for the issuing of the preliminary permit.

“Technical and Economic Analysis of the Central Waste Management Zone Marišćina” (Faculty of Civil Engineering of the University of Zagreb) was completed in September 2005. This study lays out the technological-technical analysis of the work of the Centre, with a recapitulation of the existing state of the handling of waste in the Primorsko – Goranska County. It also contains a description of the chosen process of collection, treatment, recuperation and disposal of municipal and non-hazardous industrial waste, as well as an analysis of the overall costs and income of the CWMC. Also, potential sources of financing have been explored and a model of financing proposed.

“Technical and economic concept of setting up an integrated system of municipal and non-hazardous industrial waste management in Primorsko – Goranska Country” (HIDROPLAN d.o.o., Zagreb) was completed in December 2006.

“Main Design of the Construction of the Bypass road Marčelji – Studena” (Rijeka projekt d.o.o., Rijeka) was completed in December 2005. The main design is a basis for the issuing of the construction permit and commencement of construction works.

“The Main Design of the construction of landfill cell 1A, formation of working area plateau, infrastructure (internal roads and parking places, water supply system, sewage system, WWTP, transformation station and electricity network, telecommunication network), facility for gas treatment, guard house, weighbridges and wheel wash facilities” (ECOINA d.o.o., Company for Environmental Protection, Zagreb) was completed in June 2006.

Preparation of Documentation for applying of Major project request to the Delegation of European Commission for EU co-financing through IPA Programme (Feasibility Study and Major project request with required annexes) (HIDROPLAN d.oo/Sl Consult Ltd) was completed in September 2008).
During the preparation of project documentation for submission to the Delegation of European Commission for the EU co-financing through IPA Programme the Project was revised, updated and changed in line with new National Waste Management Plant, new legislation in force and finally in line with new improved technologies to decrease negative environmental impacts.

In addition to above mentioned documents, a number of other documents were also produced, all of them closely linked to the establishment of the integral system of waste management in PGC and to the remediation of official landfills on the area of the County.

2.4 **Strategic documents for the Project**

The Project is consistent with:

- Physical Plan of the Primorsko – Goranska County (July 2000)
- Regional operative programme (ROP) of the PGC for the period 2008 – 2013

2.5 **Other relevant activities done by now:**

- Establishment of the county utility company Ekopus Ltd by PGC, City of Rijeka and Municipal Company “Čistoća” Rijeka (February 2001);
- Acceptance of the CWMC by the Ministry of Environmental Protection and Physical Planning on environmental acceptability by issuing EIA Decision (March 2003);
- Agreement on mutual relations in the Integral System of Municipal and Non-Hazardous Industrial Waste Management in PGC signed by all the LSU;
- The construction of the bypass road Marčelji – Studena has started in 2008;
- Stage I of the Project CWMC Marišćina (landfill and its corresponding facilities) is co-financed by the EU within the framework of the Instrument for Pre-Accession Assistance (IPA). Further financing sources are stemming partly from Croatian budgets on central (Environmental protection and energy efficiency Fund), regional and local level (PGC). Financing Agreement for this co-financing the Project between the Government of the Republic of Croatia and the European Commission is signed in April 2009;
– In year 2008 Ekoplus Ltd started loan negotiation with European Bank for Reconstruction and Development to ensure finance of construction of MBT Plant;

– In year 2009 Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) has requested preparation of documentation which will elaborate and compared new technical solution with given solution in Final EIS. The aim of that document is to determinate and assets changes in environmental impact. On the basis of that document MEPPPC will update EIA Decision from March 2003;

– Due to the fact that preliminary solution for preparation of EIS was done in 2001, there are some differences between proposed solutions in this concept of the Centre because of meanwhile technology improvements and new adopted legislation. The main difference is in the waste treatment, now is used improved technology with the aim to use the best available techniques in relation to the costs and ecological acceptability All main assumptions of EIA (like location, years of operating, size of the site, monitoring measures, mitigation measures) are respected. Due to that MEPPPC has required Elaborate on updates of EIA Decision for construction of CWMC "Marišćina to determinate are differences regarding the existing EIA decision acceptable for environment and in line with already given decision and legislation in force. Elaborate is made in September 2009;

– Update EIA Decision is expected to be issued by MEPPPC in October 2009.

2.6 Implementation of the project

The establishment of the CWMC and the integrated county waste management system is a long, demanding and expensive task, for the accomplishment of which the following groups of activities must be performed:

Stage 0 - Preliminary activities: land acquisition, preparation of project documentation, basic designs and permits, construction of bypass road, construction of monitoring station, displacement of electrical installation inside the CWMC

Stage 1 – construction of Landfill: includes construction of working area and of the area for disposal of treated municipal and non hazardous industrial waste, purchasing landfill equipment and waste management transport equipment (trucks with semi-trailers of 24t and 10t capacity) and supervision of works. The technical assistance will be used to establish the county waste management system and for the publicity.

Stage 2 – under this stage is foreseen construction of Mechanical Biological Treatment (MBT) Plant for treatment of municipal waste (average capacity of 100.000 t/y). Plant will use combined biological and mechanical techniques to
produce Solid Recovered Fuel (SRF). After treatment of municipal waste in MBT Plant 35% of incoming waste will be separated as SRF for further treatment outside the CWMC Marišćina and 35% will be separated as a biodegradable fraction suitable for further treatment in controlled bio-reactive landfill cell.

**Stage 3** - Transfer stations (TS) are the following essential part of the system that has to be constructed and equipped.

**Stage 4** - Taking into account that the disposing area will be filled up with time, it will be necessary to ensure new disposing areas periodically over the entire life time of the disposing area, as well as sequential closure of filled up cells. In this stage is also foreseen to construct the facility for production of electrical energy.

### 2.7 Legislation framework

In the last years numerous legislation acts regarding waste management are new adopted or updated, as well harmonised with EU legislation.

Regulations governing the area of waste management in Croatia at the moment are:
- Waste Act (OG No. 178/04, 111/06, 60/08, 87/09); Regulation on categories, types and classification of waste with a waste catalogue and list of hazardous waste (OG No. 50/05, 39/09); Ordinance on packaging and packaging waste (OG No. 97/05, 115/05, 81/08, 31/09); Decision on requirements regarding packaging labelling (OG No. 155/05, 24/06, 28/06); Waste Management Strategy of the Republic of Croatia (OG No. 130/05); Ordinance on waste tyre management (OG No. 40/06, 31/09); Ordinance on the register of legal and natural persons dealing with intermediation activity in organising waste recovery and/or disposal, and of legal and natural persons dealing with the activity of non-hazardous waste export (OG No. 51/06);
- Regulation on the criteria, procedure and manner of determining compensation to real estate owners and local self-government units (OG No. 59/06); Decision on the allowed quantity of waste tyres to be used for energy purposes in 2006 (OG No. 64/06); Regulation on supervision of transboundary movement of waste (OG No. 69/06, 17/07, 39/09); Ordinance on waste oil management (OG No. 124/06, 121/08, 31/09); Ordinance on waste batteries and accumulators management (OG No. 133/06, 31/09); Ordinance on the management of end-of-life vehicles; (OG No. 136/06, 31/09); Ordinance on waste management (OG No. 23/07, 111/07); Decision on the allowed quantity of waste tyres to be used for energy purposes in 2007 (OG No. 36/07); Ordinance on the method and procedures for managing waste containing asbestos (OG No. 42/07); Ordinance on methods and requirements for thermal treatment of waste (OG No. 45/07); Ordinance on medical waste management (OG No. 72/07); Ordinance on the management of waste electrical and electronic appliances and equipment (OG No. 74/07, 133/08, 31/09); Decision on National target of share of returnable packaging in 2008 (OG No. 82/07); Waste Management Plan of the Republic of Croatia for 2007-2015 (OG No. 85/07); Ordinance on the methods and conditions for the landfill of waste, categories and operational
requirements for waste landfills (OG No. 117/07); Ordinance on construction waste management (OG No. 38/08); Ordinance on management of wastewater treatment sludge when used in agriculture (OG No. 38/08); Ordinance on management of waste from the titanium dioxide industry (OG No. 70/08); Instruction on handling waste containing asbestos (OG No. 89/08); Ordinance on the management of polychlorinated biphenils and polychlorinated terphenils (OG No. 105/08) and Ordinance on managing waste from research and mining of mineral raw materials (OG No. 128/08).

3 ANALYSIS OF ALTERNATIVES

3.1 Location analysis

Preparation of the Preliminary Environmental Impact Study (Ekonerg Holding Ltd, Zagreb, June 1999) for “Structure for storage, treatment and disposal of municipal and non-hazardous industrial waste from the Kvarner area” is a start of the process of issuing permits for the project.

According to the legislation in force in that time, a Preliminary Study should be made if the site is not determined or is not determined in details by documents of physical planning. Namely, the draft Physical Plan of Primorsko – Goranska County (2000) did not specify the exact site for the project, but, based on the prior studies, it has determination of the wider area – a macro-location. Based on the prior research, four potential micro-locations have been determined and analysed: Dolćina, Nova and Rojno in the Municipality of Klana and Marišćina in the Municipality of Viškovo (“Report on the Results of Exploration of a New Location for the Disposal of Municipal Waste – Phase I”) IGH – Zagreb 1995,

Upon completion of the assessment of environmental impact and decision by the State Administration for Nature and Environment Protection, providing approval for the project, the final decision on the most suitable site was accepted by the Assembly of the County in agreement with the LSU (1999).

The Preliminary Study is based on numerous preliminary research for the requirements of the county physical plan, concept of the waste management system and special research aimed to find an appropriate location for the project. In compliance with the Executive Decree, the Preliminary Study is inclusive of an analysis and assessment of environmental, physical and sociological elements of environmental impact of each of the potential sites, and provides a comparison of framework expenses of the project. Considering possible environmental impact in the course of construction, operation and after termination of use of the structure, certain parameters have been determined based on which criteria may be set in order to
determine differences among locations and make possible their comparison on equal terms.

Criteria encompassed the following parameters that have been discussed and appropriately evaluated (from 1 as the lowest grade to 5 as the highest grade) for each prospective site based on the existing data and information:

- Population density / population of the area surrounding the prospective sites;
- Population along the roads planned for transport of waste to the site;
- Interventions into the natural ground and changes of landscape;
- Impacts on the intended use of the area;
- Natural features of the site (geological, seismic, hydro geologic, etc.);
- Biological and environmental features of the site and surrounding area (three separate criteria);
- Emissions into air and noise from the project and their distribution into the surrounding space under the influence of the weather.

For comparison of the sites by their total foreseeable environmental impact, a several-criteria analysis model had been applied, with weighing factors as a measure for evaluation of mutual significance of specific criteria in the process of comparison and selection of the best site, and calculation of total evaluation of each prospective site by summing up the products of specific evaluations by criteria and appropriate weighing factors.

The applied weighing factors are result of an agreement within a task force for the Preliminary Study, taking into account the knowledge and experience of the task force members as well as the prior works on this topic and standpoints of prior task force groups on mutual significance of specific criteria.

When it comes to the Preliminary Study of Environmental Impact, only the available information was processed and no additional measurements have been done. The lack of quality local weather research was particularly felt. It is important to make the most necessary measurements for the Final Study of Environmental Impacts.

The results of the comparison of sites by the group of criteria related to the environmental impact have been provided in table below.

Comparison of prospective sites by environmental criteria

| ENVIRONMENTAL, PHYSICAL AND SOCIOLOGICAL CRITERIA FOR EVALUATION |
|------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| EPS-1                  | EPS-2            | EPS-3            | EPS-4            | EPS-5            | EPS-6a           | EPS-6b           | EPS-6c           | EPS-7            |

December 2009.
In evaluation of prospective sites, only framework evaluation of the project expenses has been taken into account. For that purpose, a conceptual solution was made with technical and economic criteria, encompassing the costs of investments for the construction of the planned project, its operation (i.e. operation and maintenance costs) and transport to each site. Individual and total costs as an indication of relative technical and economic suitability of the discussed prospective sites have been presented in table below.

Comparison of prospective sites by framework project expenses in a 15 year period

<table>
<thead>
<tr>
<th>Prospective site</th>
<th>TEC-1 Actual investment and operation costs EUR</th>
<th>TEC-2 Actual costs of transport from two reference road yards EUR</th>
<th>Total actual costs EUR</th>
<th>Difference in comparison with the cheapest site EUR</th>
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<td>b – Dolčina</td>
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<tr>
<td>c – Nova</td>
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<td>6,4</td>
<td>44,3</td>
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<tr>
<td>d – Rojno</td>
<td>38,4</td>
<td>3,4</td>
<td>41,8</td>
<td>4,5</td>
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According to the framework expenses of the project, the most suitable site is Dolčina, and the sites of Nova and Marišćina are following it.

The suitability of Dolčina site is result of its very favourable position with regard to the foreseen transport corridors for transport of waste from various parts of the county.
Table below presents a comparison of the site including environmental and economic criteria, where environmental criteria have the total weighing factor 0.9 and economic criteria have the weighing factor 0.1.

### Comparison of sites by environmental impact and economic criteria

<table>
<thead>
<tr>
<th></th>
<th>Marišćina</th>
<th>Dolčina</th>
<th>Nova</th>
<th>Rojno</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental criteria</td>
<td>3.35</td>
<td>3.00</td>
<td>3.40</td>
<td>3.10</td>
</tr>
<tr>
<td>Weighing factor</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>Economic criteria</td>
<td>3.55</td>
<td>5.00</td>
<td>3.95</td>
<td>1.75</td>
</tr>
<tr>
<td>Weighing factor</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Total grade</td>
<td>3.37</td>
<td>3.20</td>
<td>3.44</td>
<td>2.97</td>
</tr>
<tr>
<td>Rang</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

As the final result of the analysis and comparison within the process of selection of the best site in this Preliminary Study, the following has been concluded:

- All discussed sites fulfil the elimination criteria and are therefore suitable for the project.
- Differences among the sites are not significant, which is understandable, as they are relatively close one to another
- By application of comparison criteria and evaluation of prospective sites, they may be classified into two groups: Dolčina and Rojno as less suitable and Nova and Marišćina as more suitable. The site of Rojno, compared to that of Dolčina, is more suitable due to expressed anthropogenic impacts. The site of Nova, compared to Marišćina, has been evaluated with a higher total grade, with a critical share of weather criterion obtained based on evaluation of probability of unsuitable weather conditions.

The Preliminary Study of Environmental Impact has been made on the basis of available data and information and the results of prior research. It can be said that the available information had been sufficient for the drafting of the Study. As the main topic of the Preliminary Study is the proposal of a preferential site for the project, it is neither possible nor justified to perform further field research for that purpose on all prospective sites.

**The crucial reason for the selection of the Marišćina as site location was that it is located only 10 km from Rijeka where far most of waste of the country is produced (72%).**

Public was involved two times first during the EIA process (as is explained in chapter 4 of this document) and the second time public was also consulted during the adoption of Physical Plans of Primorsko goranska County and Municipality of
Viškovo. In both process all stakeholders could submit opinion/question on selected location and technology.

The chosen location of the CWMC “Marišćina” is also in accordance with NWMP, where the locations of 19 WMCs in Republic of Croatia have been defined.

According to NWMP all Counties of Republic of Croatia are obliged to prepare waste management plans that will define the waste management system with not more than one WMC in each County.

Two concepts for non-hazardous (municipal and industrial) waste management have been proposed:

- the so-called county concept – one WMC in each county and
- the so-called regional concept – eight regional and five county WMCs.

Regardless of the concept selected, potential WMC locations, criteria and guidelines for their construction must be included in physical plans of the counties.

The location Marišćina for the future CWMC location has been defined in the Physical Plan of PGC in the June 2000.
3.2 **Option analysis of MBT technology**

Options analysis for MBT technology was done in the scope of Feasibility study (HIDROPLAN d.o.o./SI Consult Ltd) September 2008) and here is presented overview of that analysis.

As the mechanical and biological treatment of waste is recommended by the NWMP, option analysis in this respect is done regarding the biological treatment methods.

Three basic concepts of MBT technologies were analysed.

- MBT Plant with aerobic treatment of biodegradable fraction of waste (composting)
- MBT Plant with anaerobic treatment of biodegradable fraction of waste (Anaerobic Digestion (AD) process)
- MBT Plant with bio drying and biodegradable fraction of the waste treatment in the bioreactive landfill cell
3.2.1 Variant 1: MBT plant with aerobic treatment of biodegradable fraction of waste (composting)

Figure 7. MBT with aerobic treatment of biodegradable fraction of waste

The first step in this process is separation of flammable waste fraction from biodegradable fraction (by attrition, peep, and metal separation). After that, the biodegradable fraction is aerobically treated (composting).

One of the lacks of this kind of treatment is low quality solid recovery fuel (SRF). The reason lays in the waste pre-treatment. Namely, the waste must be very thoroughly shredded in order to separate well the dry part from biodegradable fraction of the waste. The dry part becomes moistened (calorific value < 15,000 MJ/kg and wet, moisture > 30%). For the usage in the cement factory that calorific value should be > 18,000 MJ/kg – moisture < 15 %), so it is necessary to dry that fraction additionally, which is very expensive and complicated process (app. 40€/t).

Regarding the origin of the waste, the compost produced by biological treatment does not meet the quality request for agriculture usage, and in the most cases it is used for landfill top cover.
3.2.2 VARIANT 2: MBT WITH ANAEROBIC TREATMENT OF BIODEGRADABLE FRACTION OF WASTE (ANAEROBIC DIGESTION PROCESS)

Figure 8. MBT with anaerobic treatment of biodegradable fraction of waste

In this case the waste treatment begins in the same way like the first one, with mechanical treatment and separation of the SRF fraction from the biodegradable part of waste. The second step is anaerobic treatment of biodegradable fraction in reactors, where the biogas is produced and used as a resource for electrical power production.

This SRF has calorific value < 18000 MJ/kg. This process shows some advantages, especially possibility of energy production, but the main disadvantage is relatively high treatment costs and high initial investment costs.
3.2.3 Variant 3: MBT with bio drying and treatment of rest of biodegradable fraction of the waste in the bioreactive landfill cell

Figure 9. MBT with bio drying and treatment of rest of biodegradable fraction of the waste in the bio-reactive landfill cell

In this treatment, the first step is bio-drying and it represents the biological part of treatment, followed by mechanical treatment. This technology produces two outputs, one being SRF and the other one being biodegradable fraction of waste which goes for accumulation and further anaerobic treatment in special landfill cells. The final product of the reaction in bioreactive landfill cells – bio gases are used to produce electrical energy.

Advantages of this technology is high caloric value of SRF > 18,000 MJ/kg, moisture < 15%), because of bio drying in the process of bio stabilisation.

The rest of treated waste is biodegradable, which can be further treated in bioreactive landfill cell (anaerobic treatment) where the output is biogas – electrical power.
### 3.2.4 Variant analysis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>VARIANT 1</th>
<th>VARIANT 2</th>
<th>VARIANT 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBT plant with aerobic treatment of biodegradable fraction of waste (tunnel composting)</td>
<td>MBT plant with anaerobic treatment of biodegradable fraction of waste</td>
<td>MBT plant with bio drying and treatment of rest of biodegradable fraction of the waste in the landfill</td>
<td></td>
</tr>
<tr>
<td>Investment costs</td>
<td>20 M EUR</td>
<td>25 M EUR</td>
<td>18.9 M EUR</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total operating cost of the Plant</td>
<td>35 EUR/t</td>
<td>50 EUR/t</td>
<td>19 EUR/t</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Possible Revenues</td>
<td>Metals</td>
<td>Metals, Biogas</td>
<td>Metals</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total amount of waste for final landfilling</td>
<td>30% (incl. compost for landfill covering) if SRF diverted</td>
<td>30% (incl. compost for landfill covering) if SRF diverted</td>
<td>35% when SRF diverted</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>BMW diversion</td>
<td>80% is SRF diverted</td>
<td>85% is SRF diverted</td>
<td>72% is SRF diverted</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Quality of SRF</td>
<td>low</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Compliance with NWMP</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Compliance with EU waste legislation</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Rang</strong></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sum of rang</td>
<td>15</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td><strong>FINAL RANG</strong></td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

1 - The best grade, 3 – the worst grade
3.2.5 Conclusion:

The third concept, MBT with bio drying and treatment of the remaining biodegradable fraction in the landfill showed the best grade.

The main reasons for this choice are:

- One of the outputs is high quality alternative fuel (high caloric value, low moisture) which is good for use cement factory
- Production of electrical power from renewable sources (special tariff)
- Relative acceptable amount of initial investment in the Plant
- Acceptable price of municipal waste treatment

If we compare prices of all three concept of treatment, the first one has little return of costs in treatment (compost – very low quality), second has high initial investment and high treatment costs.

It is worth mentioning as well that one of NWMP objectives is production of SRF and its usage as alternative fuel. This technology produces SRF of the highest quality and negotiating with possible customer is already in process.
4 ENVIRONMENTAL IMPACT ASSESSMENT APPROVAL PROCESS

Primorsko – Goranska County on 20th March 2003 filed a request to the Ministry of environmental protection and physical planning for the performance of environmental impact evaluation of the intended construction of the facility for storing, processing and disposal of communal and non-hazardous technological waste at Marišćina location.

Relevant Study for the evaluation of environmental impact of intended intervention, valorised and evaluated prior to the initialization of the process of issuing of location permit is the Final study of environmental impact of the facility for storing, processing and disposal of municipal and non-hazardous technological waste from Primorsko - Goranska County at Marišćina, Municipality of Viškovo. This Study encompasses all the required data, documentation, explanations and descriptions in both textual and graphic form, as well as proposed evaluation of acceptability of intervention and environmental protection measures. The study was conducted by Ekonerg Holding d.o.o. Zagreb, legal person authorised for the performance of professional jobs of preparation and compilation of environmental impact studies. Subject of the study is the impact of intended intervention at Marišćina location, selected at the session of County Assembly of Primorsko-Goranska County, held on June 3, 1999, on the basis of a preliminary study.

Commission for environmental impact evaluation appointed by the Ministry of environmental protection and physical planning, evaluated the impact of intended intervention, its evaluation and acceptability.

At the first session of the Commission, held on 1st September 2000, it was established that the Study contained elements relevant for evaluation of but it should be corrected especially when it came to the borders of fourth water-protection zone, since a small part of the future landfill was situated in the zone. Accordingly, engineering-geological investigations were conducted.

At the session of the Commission, held on 24th October 2000, it was established that all the requirements of Commission weren’t met. At the session of the Commission held on 17th January 2001, it was found that request of the Commission concerning the amending and correcting of the Study was met and the decision to deliver the Study for public insight was brought.

Public insight was performed from February 1st to 15th 2001. Public debate was held on February 8th 2001 in a hall of the Home of culture In Viškovo and Klana.

Numerous objections were made to the professional part of the Study and procedure of performance of environmental impact study during public insight and public debate. The objections were made by: mothers and wives of Viškovo district,
Municipal government of Viškovo district, Mažuran society, Club of councillors of SDP of Viškovo district, Club of councillors of PGS and LSH of Viskovo district, professor Josip Crnić, director of “Lijepa Naša”-Viškovo branch, Zoran Katić, Eduard Zoretić and Škalnica local committee.

At the session held on March 26th 2001 following public insight and public debate, compiler of the study and members of the Commission discussed and answered the objections made at public insight and brought Commission conclusion and intervention acceptability, defining measures for environmental protection and program for the monitoring of environment. Answers to the questions from public insight, following the said procedure, were sent in written form to persons who raised them.

Keeping all this in mind, Ministry of environmental protection and physical planning evaluated the foreseen environmental protection measures updated in accordance with adopted objections from public debate and found that there were no omissions in the procedure. They also found that the principle of prevention was met by harmonization and adjustment of intended intervention by taking into account possible negative impact of the intervention on all environmental components. The impact of the intended intervention on the environment and defining environmental protection measures will reduce all negative impacts to the minimum and achieve the best possible preservation of environment quality.

Republic of Croatia, Ministry of environmental protection and physical planning has issued the EIA Decision for construction of CWMC “Marišćina”, class UP/I-351-02/00-06/31 on 31th March 2003.

In the matter of the request of Primorsko – Goranska County for a decision on the performance of evaluation of environment impact study concerning the intended construction of a facility for storing, processing and disposal of communal and non-hazardous technological waste from the territory of Primorsko – Goranska County, represented by county head Zlatko Komadina, Ministry of environmental protection and physical planning, Administration for administrative and legal affairs, in accordance with article 30 of Environmental Protection Act (official journal of the Republic of Croatia. no. 82/94 and 128/99) end article 62 of Administrative suit Act (official journal, no. 53/91), brought the following decision:

- Intended construction of facility for storing, processing and disposal of communal and non-hazardous technological waste from the territory of Primorsko – Goranska County, in Marišćina, Viškovo district, is acceptable, if environmental protection measures and program for monitoring state of the environment will be implemented
Intended construction is acceptable in environmental terms, providing the environmental protection measures and program for monitoring state of the environment proscribed by this Decision are implemented.

5 DESCRIPTION OF EXISTING ENVIRONMENT

The proposed location of CWMC Marišćina is situated on the northern part of Municipality of Viškovo, approximately 10 km from the city of Rijeka. The height of the location is between 463 and 515 meters altitude, near the public road Ž 5017 Marčelji - Klana section and Ž 5023 Marčelji - Studena section. Between the road and border of location there is a 50m wide protective area.

The entire area which will be covered by the CWMC „Marišćina"is 42,5 hectares.

The area of proposed location of CWMC is not inhabited. The nearest residential settlements are Studena – 750m towards north, Klana 2200m towards north-west, Marčelji 800m towards south and Brnčići 2100m towards southwest. The area belongs to Mediterranean and mountain section and thus this is a forestry area especially with "medunac" oak and black hornbeam.

5.1 Climate

<table>
<thead>
<tr>
<th>Location</th>
<th>Northern part of municipality Viškovo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location elevation (existing condition)</td>
<td>Between 463 and 515 m AMSL</td>
</tr>
<tr>
<td>Geomorphology</td>
<td>Well developed karst terrain</td>
</tr>
<tr>
<td>Hydrogeology</td>
<td>completely water permeable rocks</td>
</tr>
<tr>
<td></td>
<td>completely watertight rocks</td>
</tr>
<tr>
<td></td>
<td>Variable water permeable creations</td>
</tr>
<tr>
<td>Seismicity</td>
<td>7 and 8 MCS</td>
</tr>
<tr>
<td>Climate</td>
<td>Mediterranean/mountain</td>
</tr>
<tr>
<td>average annual temperature (Rijeka)</td>
<td>13,6°C</td>
</tr>
<tr>
<td>Estimated average annual temperature</td>
<td>12°C</td>
</tr>
<tr>
<td>Average monthly air temperature – January</td>
<td>5,3°C</td>
</tr>
<tr>
<td>Average monthly air temperature – July</td>
<td>22,8°C</td>
</tr>
<tr>
<td>average annual rainfall</td>
<td>2152 mm</td>
</tr>
<tr>
<td>minimum annual rainfall</td>
<td>1414 mm</td>
</tr>
<tr>
<td>maximum annual rainfall</td>
<td>2777 mm</td>
</tr>
<tr>
<td>Maximum recorded 24-</td>
<td>241,9 mm</td>
</tr>
</tbody>
</table>
Meteorological indicators observed in the area are temperature and rainfalls. Data for those indicators are taken from the meteorological station in Rijeka. According to meteorological study done in 1992, the average annual temperature for Marčelji location was 12°C. The average annual temperature for the City of Rijeka is 13,6°C. The average annual temperature in January was 5,3°C and the warmest were in July – 22,8°C. Average annual quantity of the precipitation in the observed period from 1961 till 1990 was 778 mm.

5.2 Geology and Geomorphology

Geological feature of the terrain on the location of CWMC "Marišćina" is a typical karst area composed of dolomite and limestone. As the entire Primorsko Goranska County belongs to the Dinara karst area, karst cannot be avoided. During the location analyses for all 4 possible location geological conditions are assessed and Marišćina location was second most favorable. Due to karst area additional protection of lining system was foreseen, geosynthetic clay liner will be installed on 50 cm thick levelling layer.

Geomorphological features of the terrain are depressions and sinkholes.

5.3 Water resources

Based on the conducted surveys (Institute for Geological research in Zagreb) a new map of water protection areas of the City of Rijeka has been made, according to which the Marišćina site is located outside the area of the 4th sanitary protection zone, in the zone of partial restrictions.

Results of hydro geological researches have shown that there is no connection of future location of CWMC and drinking water resources (Zvir I, facility Zvir II, Martinšćica) which supply the city of Rijeka.

5.4 Biological and ecological resources

There are several natural assets around the proposed location. Distance between the protected landscape Lisina with seacoast and mountain forest from the future CWMC is approx. 20 km. Lužina and canyon Rječina are closer, approx. 5 km and 2,5 km.
5.5 Flora and fauna

Thanks to the variety of ecological conditions in wide ambient, heterogeneous flora and fauna can be found. The area belongs to Mediterranean and mountain section and thus this is a forestry area especially with medunac oak and black hornbeam.

Fauna is also very various. No surveys were conducted. According to literacy, following species can be found: mammals, birds, reptiles and insects.

There is no determined protected species at the location.

5.6 Cultural and natural heritage

On this location, there is no protected urban, rural or cultural-historical heritage that might be adversely affected by potential construction or exploitation of a landfill.

5.7 Air quality

The results regarding parameters of pollution and air quality were acquired by use of analyzers for measuring sulphur compositions, nitrogen compositions, carbon-hydroxide, ozone, carbon-monoxide, carbon-dioxide and floating particles. From the measuring of the above mentioned parameters, a conclusion may be drawn that there were discrepancies on the recommended values and limitations during the 30-day measuring (according to the ordinance on air quality limits and recommended values, Official Gazette No. 101/96).

5.8 Land use and settlement patterns

At the moment the area of proposed location of CWMC is not used for commercial purposes. The area is not suitable for agricultural use. The only possibilities of this area are forest cutting, livestock and possible exploitation of stones but nearby are much bigger areas with similar potentials.

6 DESCRIPTION OF ENVIRONMENT LIKELY AFFECTED BY PROJECT

The construction of CWMC should solve the problem of waste management which will help prevent uncontrolled environmental impacts in PGC. All other small landfills in the County will be closed when CWMC will start to operate. The construction of CWMC should minimized uncontrolled landfill gas emission and further decreasing of greenhouse gas generation and emission. In addition, by constructing a modern waste management system groundwater will be protected by constructing an impermeable
liner. Such a modern waste management system will further improve standards of living of inhabitants of PGC.

CWMC Marišćina is designed to meet Integrated Pollution Prevention and Control (IPPC) Directive (96/62/EC), due to the fact that the CWMC, including MBT plant, will need IPPC permit for operation in accordance with IPPC Directive and Croatian legislation (OG 114/2008) in force from 1 April 2009 from Ministry of Environment.

In addition to legislation requirements equipment and technology to be procured and used will meet the standards set out in IPPC Best Available Techniques Reference Document (BREF) for Waste Treatments.

A separate collection of waste will be further enhanced while CWMC will help recover usable materials from waste before final disposal of residues is carried out using fully enclosed landfill. Finally, such a modern waste management system will ensure clean and protected environment enabling further develop sustainable tourism.

The proposed project involves construction of CWMC which will be designed and built according Croatian and EU environmental standards and guidelines. The potential environmental, social, health and safety impacts of the construction and operation of the CWMC might refer to:

- Air emissions, gas emissions and noise
- Soil, surface water and groundwater pollution
- Flora and fauna
- Landscape
- Community health and social aspect
- Occupational health and safety issues

During the construction works the usual construction mechanization will be used, which generate average level of noise of 95 - 85 dB (A). In addition, transportation vehicles and human activity might generate additional level of noise. Transportation vehicles and construction machinery need to be regularly checked. Raised noise levels at the building site are inevitable, but they are temporary and might generate short time impact, whereas the inhabitants of the near-by houses will not be affected.

As is mentioned in the previous chapter at the moment the area of proposed location of CWMC is not used for commercial purposes. The area also is not suitable for agricultural use. The only possibilities of this area are forest cutting, livestock and possible exploitation of stones but nearby are much bigger areas with similar potentials.
The area is not inhabited. Distances to the closest settlement towards different directions are:

- Studena 750 m to north;
- Klana 2200 m to north-west;
- Marčelji 800 m and Kosi 1700 m to south and
- Brnčići 2100 m to north.

Transformation of the proposed area into the landfill will result with the loss of natural habitat of 42,5 ha area. Composition, constitution and function of habitat will be changed. Modification of the area, presence of people, increased frequency of vehicles on roads and pollution are the elementary changes which will have influence on the landfill environment.

The influence of the construction of landfill on the bio-variety of this area is almost minor since the affected area is relative small.

Therefore the aspect of the environment which shall be affected by the proposed project relates to the air, water, soil and biologically and ecologically features. Consequently, several investigations were conducted: hydro geological and geological with a view to affect the drinking water resources, meteorological measures of parameters like direction and wind velocity, air temperature, relative air humidity, air pressure and total emission and air quality parameters.

As there is no protected natural, urban, rural, cultural and historical assets in the vicinity of the site as CWMC could have affects on those assets.

Project CWMC Marišćina will have positive impact on overall community health and social aspects on the entire County due to the fact that all existing dumpsites in the County will be closed.

As the land is ensured and it has not any commercial value, land acquisition and economic displacement issues will not have additional negative social-economic impacts.

It is foreseen that 39 people will be hired at the CWMC which will have also good social-economical impact of the project.

Health and safety at the CWMC Marišćina of will be elaborated by the Health and safety Plan for construction phase and separately for operating phase of CWMC in project Main design. Both Plans will define safety procedures at the CWMC. During the construction and operation of the CWMC following hazards are potentially present: trip hazard due to uneven ground, falls into drainage channels and void spaces, potential for encounter with flammable, explosive and toxic gases and fumes, both sub-soil and airborne, hazardous materials may potentially become exposed due to ground movement or
unauthorised excavation, turning and reversing heavy vehicles and plant, lifting and handling of materials, and operation of heavy equipment, etc.

6.1 Impact of waste transport

Due to increased frequency of transport during construction and waste transport later during operation, of CWMC, it is expected that a number of vehicles might be significantly increased traffic on local roads. It is estimated that approx 100 trucks will arrive at the CWMC.

Due to decrease that impact EIA decision requires prior to putting the landfill into operation, construction of new CWMC access road GMC 103. With that road settlements on existing access road will be protected from transport impact. The road GMC 103 was planned for general development of Municipality of Viškovo and as well for relieving of existing roads. It will be built independent of the Project CWMC Marišćina. Under the moment the Transport Study is under preparation. This Study shall give most appropriate transport routes to the CWMC Marišćina until the road GMC 103 will be constructed. Construction of road GMC 103 is foreseen in three phase, construction of phase one is already started; for stage 2 technical documentation has been prepared and documentation for phase three is currently under preparation.

Figure 10. Route of future road GMC 103
7 MITIGATING MEASURES

The landfill operator Ekoplus Ltd shall ensure the implementation of environment protection measures and monitoring programme described by EIA decision.

Protective and mitigation measures which need to be carried out during design, implementation, operation and maintenance are as follows:

7.1 Environmental protection measures to be applied during the construction of the landfill

- Prior to putting the landfill into operation, the road termed GMC 103 in the county physical plan must be built;
- Excavated material must be deposited in a suitable place, to allow its use in the construction of roads and other infrastructure, daily covering of waste, construction of temporary and permanent causeways and individual parts of base and cover layer;
- Base and cover sealing layer and flanks of the landfill must be protected by an impermeable layer of mineral material, the permeability of which must be equal to or lesser than that of the 1 meter thick layer of natural material, with permeability coefficient of $10^{-9}$ m/s. Such sealing layer must not be less than 0.5 meters thick;
- A drainage canal for collection of surface waters and waters from enclosed parts of the landfill must be constructed around the entire landfill;
- Landfill must be enclosed by a fence not less than 2 meters high;
- A fire protection belt 4-6 meters wide must be constructed around the fence and tall vegetation must be planted or extant vegetation kept around that belt;
- Devices and equipment for raising fire alarms, extinguishing fires and protection against spreading of fire must be installed in the landfill;
- Guarding service must be insured at the landfill;
- Landfill must be equipped with devices for compacting and covering disposed waste.
7.2 Environmental protection measures to be applied during operation of the landfill

**General measures:**

- Waste brought to the landfill must be controlled. Only municipal and non-hazardous industrial waste can be stored, processed and disposed at the landfill;
- Wheels of vehicles leaving active landfill zone must be washed;
- Landfill must be covered with a layer of earth or fire-proof foil on a daily basis;
- Bad odours must not be detectable more than 100 meters from the landfill fence;
- Pest control and debugging must be carried out by licensed organizations;
- Native species with roots which will not compromise the hardness of lower layers of upper sealing layer of the landfill, must not be used for restoration of individual parts of the landfill;
- If during the processing of communal and non-hazardous technological waste, substances which can be considered hazardous substances or hazardous waste (e.g. waste oils, etc. from discarded cars or household appliances) emerge, they must be temporarily stored at a separate warehouse, designed to eliminate any possibility of leaks, wind dispersal or scattering of materials into the environment.

**Waters**

- Waters which need filtering must first be collected in collecting pools and lead to the filtering device;
- Car or equipment wash water must be processed by oil and grease separator and deposit drum, and then lead to the collecting pool;
- Waste waters produced in the sorting and composting process must be lead to collecting pools;
- Water from collecting pools can be used for waste spraying in the dry season, for the purposes of better waste compacting, during extreme precipitation and any out-of-the-ordinary situations in which such action can prevent the leaking of non-purified waste into the environment;
- Water let out into the environment must meet quality criteria to be discharged into the natural recipient according to the Ordinance on Boundary Values of
Dangerous and Other Substances in Waste Waters (OG 94/08), standards prescribed by that Ordinance are in compliance with EU standards;

– Sanitary waste waters must be lead to the wastewater treatment plan;

– Silt produced in the waste water purification process must be analyzed and composted, if it is suitable for composting. If it is not suitable for composting, it must be disposed at the waste landfill.

**Air**

– Waste gasses must be collected and processed;

– Waste gas collecting system must be constructed to allow the measuring of gas emissions into the environment;

– Collected waste gasses must be burnt in a closed-type torch, not less than 10 meters high at a temperature of 850 degrees centigrade, for a minimum period of 0,6 seconds;

– Waste must be sorted and composted in an enclosed space. Mechanical impurities from air from such spaces must be removed in a water curtain, by a bio-filter, to reduce the emission of unpleasant odours to less than 1 000 OU/m3;

**Noise**

– During the construction and work, noise intensity at critical places in the vicinity of the waste landfill must be measured when crusher and other devices are in operation;

– At the border with the closest building area, allowed level of noise is 40 dBA at night and 50 dBA during the day.

**7.3 Measures of environmental protection against possible ecological accidents**

– Compile an operational plan of environmental protection interventions, prior to putting the waste landfill into operation;

– At the landfill, in the waste sorting center and at the composting plant, action plan in case of accident must be placed in a visible place.

**7.4 Measures of environmental protection following end of use**

– Following the closing of the waste landfill, all measures concerning gathering and processing of waste landfill gasses and waste waters remain in force;

– Waste water purification system must be reconstructed following the closing of the waste landfill, in accordance with regulations applicable at the time.
8 REQUIRED MONITORING PROGRAM

The required monitoring program is prescribed by the EIA decision. According to existing legislation landfill operator – Ekoplus Ltd will be responsible for implementation of the prescribed monitoring. Criteria to be monitored will be defined according to the relevant legislation in force, as well as consequences of findings in excess of these criteria. Monitoring is obligatory\(^1\) as follows:

8.1 Control of meteorological parameters at the landfill

- Measurement of meteorological parameters includes daily measurement of the volume of precipitation, temperature, direction and force of wind, atmosphere humidity and evaporation;
- In the after-care phase measurement shall be carried out once a month for the next 5 years;
- Meteorological parameters may be collected from the nearest meteorological station belonging to the national meteorological network;
- Measuring of meteorological parameters must begin 6 months prior the start of construction works at the location.

8.2 Control of substance emissions from the landfill into the air

- Composition of waste gases must be established every three months, by measuring: gas quantity, humidity, particles, methane, carbon dioxide, hydrogen, sulphide, hydrogen and oxygen;
- Once a year, gas must be tested for quantities of carbon-monoxide, nitrogen, PCB, halogenous hydrocarbons, total sulphur, alcohol and BTX (benzol, toluene and xylene);
- every six months during the first five years of waste disposing, emission of solid particles, organic matter in form of vapour gas (total carbon), hydrogen chloride, hydrogen monoxide must be measured on the torch for burning landfill gases;
- Measuring of landfill gas concentrations in air includes: Monthly measuring of the concentrations of CH4, CO2 and O2 in landfill gas during the operational phase and every 6 months after closure. Measurement of other landfill gases

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\(^1\) Note: Monitoring program shall also include prescribed monitoring required by the legislation in force.
(H2S and H2) shall be carried out depending on the composition of the deposited waste or if it is so prescribed in the landfill permit.

- Measurement shall be carried out on a representative number of samples.
- The efficiency of the landfill gas extraction system must be checked on a regular basis.
- If identical measuring results for landfill gas composition and concentration are repeatedly obtained, the period between two consecutive measurements may be extended but cannot be longer than six months.
- The following indicators of air quality must be constantly monitored: NO, NO2, NOX, O3, SO2, total floating particles, total sediment, quality of insoluble matter, quantity and composition of Pb, Cd and Tl soluble matter, quantity and composition of Ca++ , Cl-, SO4 and chemical make up of precipitation
- Air quality must be begin one year prior to the beginning of construction of landfill, 24h samples must be analyzed (monthly sample for total sediments). Average time is one hour or 24 hours, with exception of total floating particles (24h exclusively), while a monthly pattern is applicable to total sediments
- In the after-care phase landfill gas concentrations shall be measured every six months.

### 8.3 Control of substance emissions in leachate and precipitation water at the landfill

- Measurement of leachate parameters is carried out every three months and includes the volume and composition of leachate during the operational phase and every six months after closure.
- The scope of measuring leachate parameters shall be determined in the water rights permit, pursuant to a special regulation on water protection and/or within the environmental impact assessment procedure.
- As part of measuring the leachate composition, conductivity shall also be measured.
- Parameters which are measured must reflect the leachate properties.
- Measurement shall be carried out on a representative number of samples.
- The scope of measurement of leachate parameters from the shed, manoeuvring areas or covered areas of the landfill shall be determined in the water rights permit, pursuant to a special regulation on water protection.
8.4 Control of groundwater at the landfill

- Control water quality at the inlet and outlet of purification device

- As the groundwater flow is generally unknown due to the karst area, during the investigation works is determined direction of groundwater's towards to the springs Cerovice and Pod Jelšuna, accordingly they are selected as the monitoring point for control of groundwater;

- at said places, all indicators from table 1 of Rulebook on border values of indicators of hazardous and other substances in waste waters (OG 40/99) must be controlled four times a year

- Ph, colour, smell, total suspended matter, KPK, bpk-5, ammonium, carbolic acid, total organic carbon, critical heavy metals and fluorides must be controlled twice a month

- ph, smell and colour must be controlled on daily basis

- water quality indicators from the preceding period must be analyzed every two years, and list of indicators to be monitored in the future must be complied accordingly

- In the first year of operation measurement must be performed on a monthly basis. If the values of measured parameters remain identical, later during landfill operation measurement of these parameters may be performed once every 3 months, and after closure once every 6 months.

8.5 Topography of the landfill body

- In operating stage structure and composition of landfill body (surface occupied by waste, volume and composition of waste, methods of disposing, time and duration of disposing, calculation of the remaining capacity still available at the landfill) shall be monitored on yearly biases and in after –care phase landfill settlements shall be measured on yearly basis.